The goal of this analysis is to investigate whether reducing the speed limit will reduce vehicle collisions with roe deer. To answer this question, we used logistic regression to estimate the probability of collisions on the road segments chosen by Viken commune and estimated how that probability changed with speed limit, as well as other landscape properties to determine if reducing the speed limit was the best management action available to the commune. We examined a series of different models to determine differences in collision probability.

We began by modelling single explanatory variables to determine which explained probability of collision better than chance alone. Based on these single variable models, distance to forest and the proportion of urban cover did better at explaining variation in the probability of collision than speed. Because speed and urban cover are tightly correlated (speed limits decline in developed areas like towns) they cannot be modelled together, so we created two “routes” of modelling, one explores the effect of speed on collision probability because this was the original question posed by the commune, while the other explores the affect of urban cover, because this is indicated as the better explanatory variable.

In the end, we use two different models (one for speed and one for urban cover) with all variables we hypothesized to affect the probability of collision which we compared to one another, as well as a model with only speed and the intercept only model. The urban cover model performed much better than the speed model, though speed still influenced collision probability (Table 1).

When we consider speed alone, an increase of 10 km/h is associated with ~ 4% increase in collision probability (Figure 1). Therefore, there is strong evidence that reducing the posted speed limit will lower the probability of a collision. However, ~ 4% difference is relatively small, and the commune may be interested in other avenues to reduce collision probability or use several methods together in areas particularly prone to collisions. Distance to forest was the best univariate model and had strong support in the full models. Increasing the distance between the road and forest cover is another method to reduce the probability of collision. To compare distance to forest to speed, reducing the speed limit by 10 km/h reduced the probability of collision by ~ 4%, but increasing the distance from the roads to forest by 65 meters also reduced the probability of collision by ~ 4% (Figure 2). Thus, cutting forest back along roads is another management option that can be done by it’s self or in addition to a reduction in speed. The relationship between distance to forest and the collision is not a linear relationship and depends on the posted speed limit (Figure 3). The probability of a collision decreases sharply as distance to forest goes for 0 to 250 m, but the effect size decreases beyond that, likely because removing forest near the road increases a driver’s visibility, and more than 250 meters of clear visibility is unnecessary. In addition, the difference in probability of collision between a posted speed limit of 70 or 80 km/h and 60 km/h is much greater than the difference between 60 and 50 km/h.

Tables and figures

Table 1. Model selection table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model name | Ka | ΔAICc | Model Likelihood | *w*ib |
| URBAN COVER\_FULL | 6 | 0.00 | 1 | 1 |
| SPEEDf\_FULL\_INX | 13 | 41.64 | 0 | 0 |
| SPEEDf\_FULL | 9 | 49.29 | 0 | 0 |
| SPEEDc\_DIST FOREST | 6 | 321.44 | 0 | 0 |
| URBAN COVER\_DIST FOREST | 3 | 335.14 | 0 | 0 |
| SPEEDf\_FORESTCOVER | 6 | 574.46 | 0 | 0 |
| DIST FOREST | 2 | 575.96 | 0 | 0 |
| SPEEDf\_TRAFFIC | 6 | 576.57 | 0 | 0 |
| SPEEDf\_EFFICIENCY | 6 | 605.60 | 0 | 0 |

aNumber of parameters estimated in the model

bAICc model weight

A graph of a speed limit

Description automatically generated

Figure 1. Modelled relationship between posted speed limit and probability of vehicle collision with roe deer in Viken kommune, Norway.

A graph of a forest cover

Description automatically generated

Figure 2. Modelled relationship between distance to forest cover and probability of vehicle collision with roe deer in Viken kommune, Norway.

A graph of a forest cover

Description automatically generated

Figure 3. Modelled relationship between distance to forest cover and probability of vehicle collision with roe deer dependent on posted speed limit in Viken commune, Norway. Model output is calculated form the second-best model, which was the full speed model which included all land cover types except urban and agriculture as well as an interaction between speed and distance to forest cover.

A graph of a graph of a forest cover

Description automatically generated with medium confidence

Figure 4. Distribution of distance to forest in the three highest speed zones (60, 70, and 80 km/h) of confirmed collisions (blue) and random background points (green).